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KEY FACTS/ASSUMPTIONS REGARDING STRUCTURE AND FUTURE DIRECTIONS -
GEO AND LEO MARKETS AND RELATED LAUNCH SERVICES

GEO Market

A. Commercial Market Size

1. COMSTAC projections for demand for commercial launches remain the most accurate and reasonable available to the United States Government.

-- 17 commercial payloads average per year.

-- 12-15 commercial launches average per year taking into account possible dual-manifesting.

-- Beyond the 1995-96 period, actual demand could deviate from current projections in either direction for various reasons. Factors which might boost demand significantly above these estimates include:

- o greater than anticipated growth in satellite use, especially in Pacific region;

- o increases in demand for new satellite services, such as direct broadcasting or high-rate data communications; or

- o the emergence of currently unforeseen satellite services or technologies.

B. Market Distribution within GEO

1. Current trends toward larger telecommunications satellites likely will continue over the 6-7 year life of the agreement. Result will be that approximately 70 percent of commercial launches per year likely will require Atlas size or larger launchers, as opposed to approximately 55 percent in the 1989-1994 period.

2. Growth in satellite size could be slowed if miniaturization technologies in satellites begin to take hold (or technologies such as digital compression, allowing more channels per transponder, lead to smaller satellites). This would sustain greater demand for medium-class launch vehicles. However, it is unlikely that this development would significantly affect the market prior to 1997-98.

C. Government launch needs are expected to remain stable over the period.

1. United States

(a) In Delta class, government requirements will fall within the 4-8 launches per year range. Average of 6 per year is reasonable.

(b) In the Atlas class, government requirements will fall within the 2-5 launches per year range. Average of 3.5 per year is reasonable.

2. Arianespace

(a) Government launches comprise approximately 20 percent of Ariane's total manifest on average and put little constraint on its capacity to meet launch requirements.

3. Russia and China

(a) Absolute levels are much more difficult to predict but are not likely to increase significantly nor represent a significant constraint on capacity to meet launch requirements.

D. In the 1995-2001 period overall, there is no structural shortage of launch capacity to meet launch requirements, either in the aggregate or in individual launch vehicle weight categories.

1. Western Providers

(a) Ariane - Ariane's current launch rate of 12 per year can be expected to increase by 4 to 8 launches per year in 1996-97 with the introduction of the Ariane 5. The precise magnitude and timing of the incremental increase will be determined by any difficulties Ariane experiences in the introduction schedule for the Ariane 5. Total Ariane capacity will also be affected by the eventual phase-out date for the Ariane 4 (currently scheduled for 1998-99, though the date may be postponed).

(b) U.S.

-- Delta - East Coast - has a demonstrated ability to launch at the rate of 12 per year to GEO (but can surge to higher levels for temporary periods). Actual launches have averaged nearly 8 per year over the last 5 years.

-- Atlas - has a target launch rate of 10 per year by 1997. Over the last 5 years, it has had a target launch rate of 8 per year and has actually launched in the range of 3-6 per

year.

The projected Atlas launch rate of 10 per year is based upon launch processing improvements at its East Coast facility. Improvements in Delta annual launch rates to GEO of 2-3 per year could be achieved in 1 year with reasonable infrastructure improvements (these currently appear unlikely).

2. Economies in Transition

(a) Russia - best estimates are a launch capacity of substantially better than 13 per year for the Proton and a record of actually launching at that rate.

(b) China - GEO launch capacity of approximately 6 per year. Since 1989, China has averaged nearly 2 launches to GEO per year.

E. In 1995-96 time frame, Western launch manifests are tight in the Atlas-class category. No such tightness exists in the Delta-class category in any period between now and 2001.

1. Ariane - Current best predictions are that it is completely booked for 1995 and 1996 (at 12 and approximately 11 launches, respectively).

2. Atlas - Current best predictions are that it is entirely booked for 1995 (at 8 launches). Current 2 slots available in 1996 may be affected by slippage from 1995.

1995-1996 time frame has been acknowledged for some time to be a period of high launch demand. COMSTAC analysis concludes that a demand softening in the latter part of the decade should make continuation of tight situation unlikely.

However, significant launch delays by Western providers, due to an inability to meet target launch rates, failure to complete critical infrastructure modernization on schedule or as a result of launch failures, could extend the Western capacity constraints through 1997. It is not clear whether difficulties in the introduction of Ariane 5 would contribute to such constraints or merely result in launch rates for Ariane 4 being maintained at higher levels than currently planned.

LEO Market

A. Demand

1. DOT estimates as reflected in March 1994 analysis are reasonable but uncertainties abound. Those

estimates are for approximately 200-250 payloads through the year 2000.

2. LEO market actually has at least three components which further complicates generalizations and aggregate market projections.

- Constellation deployment - For the large projected LEO telecommunications constellations, initial deployment involves the launch of large numbers of satellites in a relatively short period of time. More likely to involve the use of larger launch vehicles (capable of launching to GEO) with multiple payloads per launch. Risk minimization and deployment demands make distribution of launches among numerous launch suppliers both a necessity and a prudent business decision.

- Constellation replacement - This can either be to address launch or satellite failures in initial deployment or anticipated regular satellite replacement/system upgrade. Some combination of multiple-payload GEO-capable vehicles and smaller LEO vehicles (usually single or dual-manifested) will serve this function.

- Other - Expected commercial development in remote sensing and microgravity/scientific sectors will generate a demand for smaller LEO-only single payload vehicles totally independent of the LEO communications systems.

3. Demand projections

- LEO constellation deployment - 4-8 medium to large vehicle launches per year during deployment phase (based on 1-2 large LEO systems plus one little LEO system). If a third large LEO system is deployed before the end of the decade, 1-2 more large vehicle launches per year would be required for deployment.

- Single-payload LEO Launches - 8-12 small vehicle launches per year for the base case, with an additional 1-2 launches if a third large system is deployed.

B. Launch Capacity

1. Delta - West Coast - 6-8 launches per year

2. Atlas - West Coast - No effective capacity 1994-96. Projection of 4 per year thereafter.

3. Long March - 4-7 per year.

4. Proton and Ariane - No separate launch capability. LEO launches would use same facilities and be included in the aggregate launch capacity cited for GEO above.

5. Single-payload U.S. vehicles - Still very difficult to predict with certainty. 1995-1998 - 13-18 per year. 1999-2001 - 25+ per year.

C. Demand/Capacity Relationship

1. LEO launch capacity for all forms of launches would seem to be more than adequate to meet projected demand. Further, launches to LEO are not expected to significantly impinge upon GEO launch capability. If a LEO constellation mega-system (such as Teledesic) proceeds, however, a serious launch capacity constraint may be created.

2. With regard to single-payload LEO vehicles, use of excess ballistic missiles, either in the United States or abroad, would create structural excess supply throughout the decade.

3. Depending upon the exact deployment plan and design for a given LEO constellation, other than Iridium, a significant number of LEO launches can be done from U.S. facilities on the East Coast. Based upon the information to date, it is expected that the launch sites for proposed LEO constellations will be approximately split between the West and East Coasts.

D. LEO Constellations - Special Factors in Launch Supplier Selection

1. The nature of LEO constellations is such that factors other than the normal commercial considerations of price and quality may influence the selection of launch suppliers. Among those factors (in no hierarchical order) are:

- considerations of equity participation by launch supplier governments, as well as market access;
- timing constraints on deployment;
- minimizing risks of excessive reliance on narrow launch supplier base;
- pad availability;
- price per payload as opposed to price per launch;
- efficiency of delivery of satellites to necessary orbital planes (polar, other).